WE CLAIM:

1. A composition for electromagnetic energy-controlled generation and release of a gas comprising:

an energy-activated catalyst capable of being activated by electromagnetic energy, and

a solid or a solids-containing suspension containing anions capable of being oxidized or reacted to generate at least one gas,

the composition, when exposed to electromagnetic energy, being capable of generating and releasing the gas after activation of the catalyst and oxidation or reaction of the anions.

2. The composition of claim 1 wherein the solid is a salt, an inert material, a polyelectrolyte, a solid electrolyte, or a solid solution.

3. The composition of claim 1 wherein the solids-containing suspension is an emulsion or a dispersion.

4. The composition of claim 1 wherein the catalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

5. The composition of claim 4 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide,

manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

6. The composition of claim 1 wherein the anions are selected from the group consisting of chlorite, bisulfite, sulfite, hydrosulfide, sulfide, hypochlorite, cyanide, bicarbonate, carbonate and nitrite.

7. The composition of claim 1 wherein the gas is selected from the group consisting of chlorine dioxide, sulfur dioxide, hydrogen sulfide, chlorine, dichlorine monoxide, hydrocyanic acid, carbon dioxide, nitrogen dioxide, nitric oxide, nitrous oxide and ozone.

8. A composition for electromagnetic energy-controlled generation and release of a gas comprising:

an energy-activated catalyst capable of being activated by electromagnetic energy, and

anions capable of being oxidized or reacted to generate at least one gas selected from the group consisting of chlorine dioxide, carbon dioxide, sulfur

dioxide, hydrogen sulfide, dichlorine monoxide, hydrocyanic acid, nitrogen dioxide, nitric oxide, nitrous oxide, and ozone,

the composition, when exposed to electromagnetic energy, being capable of generating and releasing the gas after activation of the catalyst and oxidation or reaction of the anions.

9. The composition of claim 8 wherein the catalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

10. The composition of claim 9 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide, manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$;

and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

11. A composition for electromagnetic energy-controlled generation and release of at least one gas comprising:

an energy-activated catalyst capable of being activated by electromagnetic energy; and

chlorite, nitrite, or peroxide anions;

the composition, when exposed to electromagnetic energy, being capable of generating and releasing chlorine dioxide, a nitrogen oxide, or ozone after activation of the catalyst and oxidation or reaction of the anions.

12. A powder for generating at least one gas comprising:

a core containing an energy-activated catalyst capable of being activated by electromagnetic energy, and

particles or a layer on a surface of the core, the particles or the layer containing anions capable of being oxidized or reacted to generate at least one gas,

the powder, when exposed to electromagnetic energy, being capable of generating and releasing the gas after activation of the catalyst and oxidation or reaction of the anions.

13. The powder of claim 12 wherein the layer is continuous.

14. The powder of claim 12 wherein the layer and the particles are on the surface of the core.

15. The powder of claim 12 wherein the catalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric

semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

16. The powder of claim 15 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide, manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

17. The powder of claim 12 wherein the anions are selected from the group consisting of chlorite, bisulfite, sulfite, hydrosulfide, sulfide, hypochlorite, cyanide, bicarbonate, carbonate and nitrite.

18. The powder of claim 12 wherein the gas is selected from the group consisting of chlorine dioxide, sulfur dioxide, hydrogen sulfide, chlorine, dichlorine monoxide,

hydrocyanic acid, carbon dioxide, nitrogen dioxide, ~~nitric oxide,~~ nitrous oxide and ozone.

19. A powder for generating at least one gas comprising:
a core containing an energy-activated catalyst capable of being activated by electromagnetic energy, and
particles or a layer on a surface of the core, the particles or the layer containing chlorite, nitrite, or peroxide anions,
the powder, when exposed to electromagnetic energy, being capable of generating and releasing chlorine dioxide, a nitrogen oxide, or ozone after activation of the catalyst and oxidation or reaction of the anions.

20. The powder of claim 19 wherein the layer is continuous.

21. The powder of claim 19 wherein the layer and the particles are on the surface of the core.

22. The powder of claim 19 wherein the catalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

23. The powder of claim 22 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide, manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and

$Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

24. A method for providing controlled release of at least one gas comprising:
(a) providing a solid or a solids-containing suspension containing an energy-activated catalyst and anions capable of being oxidized or reacted to generate at least one gas, and
(b) exposing the solid or the solids-containing suspension to electromagnetic energy to activate the catalyst and oxidize or react the anions to generate and release the gas.

25. The method of claim 24 further including after step (b) the step (c) of preventing electromagnetic energy from contacting the solid or the solids-containing suspension to stop or minimize generation and release of the gas from the solid or the solids-containing suspension.

26. The method of claim 25 further including after step (c) the step (d) of exposing the solid or the solids-containing suspension to electromagnetic energy to resume

or increase generation and release of the gas from the solid or the solids-containing suspension.

27. The method of claim 24 wherein the solid is a powder, a film, a coating, or a fiber.

28. A method of retarding, killing, preventing or controlling microbiological contamination on a surface of a material, within the material or in the atmosphere surrounding the material, comprising placing a material adjacent to a composition that does not release a biocidal gas in the absence of electromagnetic energy, and exposing the composition to electromagnetic energy to generate and release at least one biocidal gas from the composition into the atmosphere surrounding the material.

29. A method of retarding, preventing, inhibiting or controlling biochemical decomposition on a surface of a material or within the material comprising placing the material adjacent to a composition that does not release a biochemical decomposition-inhibiting gas in the absence of electromagnetic energy, and exposing the composition to electromagnetic energy to generate and release at least one biochemical decomposition-inhibiting gas from the composition into the atmosphere surrounding the material.

30. A method of controlling respiration of a material comprising placing the material adjacent to a composition that does not release a respiration-controlling gas in the absence of electromagnetic energy, and exposing the composition to electromagnetic energy to generate and release at least one respiration-controlling gas from the composition into the atmosphere surrounding the material.

31. A method of deodorizing a surface of a material or the atmosphere surrounding the material or enhancing freshness of the material, comprising placing a material adjacent to a composition that does not release a deodorizing gas in the absence of electromagnetic energy, and exposing the composition to electromagnetic energy to generate and release at least one deodorizing gas from the composition into the atmosphere surrounding the material.

32. A method of retarding, preventing, inhibiting, or controlling chemotactic attraction of an organism to a material, comprising placing a material adjacent to a composition that does not release an odor-masking gas or an odor-neutralizing gas in the absence of electromagnetic energy, and exposing the composition to electromagnetic energy to generate and release at least one odor-masking gas or odor-neutralizing gas from the composition into the atmosphere surrounding the material.

33. A method of retarding, preventing or controlling biological contamination of an atmosphere comprising exposing the composition to electromagnetic energy to generate and release at least one decontaminating gas from the composition into the atmosphere surrounding the composition.

34. A method of retarding, preventing or controlling biological contamination of a material comprising placing the material adjacent to the composition, and exposing the composition to electromagnetic energy to generate and release at least one decontaminating gas from the composition into the atmosphere surrounding the material.

35. A method of retarding, killing, preventing, or controlling microbiological contamination, or retarding, preventing, inhibiting, or controlling biochemical decomposition on a surface of a material, within the material or in the atmosphere surrounding the material, deodorizing a surface of a material or the atmosphere surrounding the material, enhancing freshness of the material, or retarding, preventing, inhibiting, or controlling chemotactic attraction of an organism to a material, comprising placing a material adjacent to a composition that does not release chlorine dioxide gas in the absence of electromagnetic energy, and exposing the composition to electromagnetic energy to generate and release chlorine dioxide gas from the composition into the atmosphere surrounding the material.

36. A process for preparing a powder providing controlled sustained release of at least one gas, the process comprising:

admixing an energy-activated catalyst and particles containing anions capable of being oxidized or reacted to generate at least one gas with a solvent to form a suspension, and

forming a powder from the suspension,

the powder, when exposed to electromagnetic energy, being capable of generating and releasing the gas after activation of the catalyst and oxidation or reaction of the anions.

37. The process of claim 36 wherein the particle is a salt selected from the group consisting of an alkali metal chlorite, an alkaline-earth metal chlorite, a chlorite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal bisulfite, an alkaline-earth metal

bisulfite, a bisulfite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal sulfite, an alkaline-earth metal sulfite, a sulfite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal sulfide, an alkaline-earth metal sulfide, a sulfide salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal hydrosulfide, an alkaline-earth metal hydrosulfide, a hydrosulfide salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal nitrite, an alkaline-earth metal nitrite, a nitrite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal hypochlorite, an alkaline-earth metal hypochlorite, a hypochlorite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal cyanide, an alkaline-earth metal cyanide, and a cyanide salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine.

38. A composition for photo-controlled generation and release of at least one gas comprising:

a photocatalyst capable of being activated by light, and

a solid or a solids-containing suspension containing anions capable of photo-oxidizing or reacting to generate at least one gas,

the composition, when exposed to light, being capable of generating and releasing the gas after activation of the photocatalyst and photo-oxidation or reaction of the anions.

39. The composition of claim 38 wherein the solid is a salt, an inert material, a polyelectrolyte, a solid electrolyte, or a solid solution.

40. The composition of claim 38 wherein the solids-containing suspension is an emulsion or a dispersion.

41. The composition of claim 38 wherein the photocatalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

42. The composition of claim 41 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide, manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$

wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

43. The composition of claim 38 wherein the anions are selected from the group consisting of chlorite, bisulfite, sulfite, hydrosulfide, sulfide, hypochlorite, cyanide, bicarbonate, carbonate and nitrite.

44. The composition of claim 38 wherein the gas is selected from the group consisting of chlorine dioxide, sulfur dioxide, hydrogen sulfide, chlorine, dichlorine monoxide, hydrocyanic acid, carbon dioxide, nitrogen dioxide, nitric oxide, nitrous oxide and ozone.

45. The composition of claim 38 wherein the light is ultraviolet light or visible light.

46. A composition for photo-controlled generation and release of at least one gas comprising:

a photocatalyst capable of being activated by light, and

anions capable of photo-oxidizing or reacting to generate at least one gas selected from the group consisting of chlorine dioxide, carbon dioxide, sulfur dioxide, hydrogen sulfide, dichlorine monoxide, hydrocyanic acid, nitrogen dioxide, nitric oxide, nitrous oxide and ozone, the composition, when exposed to light, being capable of generating and releasing the gas after activation of the photocatalyst and photo-oxidation or reaction of the anions.

47. The composition of claim 46 wherein the photocatalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric

semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

48. The composition of claim 47 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide, manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

49. The composition of claim 46 wherein the light is ultraviolet light or visible light.

50. A composition for photo-controlled generation and release of at least one gas comprising:

a photocatalyst capable of being activated by light, and

chlorite, nitrite or peroxide anions,

the composition, when exposed to light, being capable of generating and releasing chlorine dioxide, a nitrogen oxide, or ozone after activation of the photocatalyst and photo-oxidation or reaction of the anions.

51. A powder for generating at least one gas comprising:

a core containing a photocatalyst capable of being activated by light, and

particles or a layer on a surface of the core, the particles or the layer containing anions capable of photo-oxidizing or reacting to generate at least one gas, the powder, when exposed to light, being capable of generating and releasing the gas after activation of the photocatalyst and photo-oxidation or reaction of the anions.

52. The powder of claim 51 wherein the layer is continuous.

53. The powder of claim 51 wherein the layer and the particles are on the surface of the core.

54. The powder of claim 51 wherein the photocatalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

55. The powder of claim 54 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide,

manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide; the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

56. The powder of claim 51 wherein the anions are selected from the group consisting of chlorite, bisulfite, sulfite, hydrosulfide, sulfide, hypochlorite, cyanide, bicarbonate, carbonate and nitrite.

57. The powder of claim 51 wherein the gas is selected from the group consisting of chlorine dioxide, sulfur dioxide, hydrogen sulfide, chlorine, dichlorine monoxide, hydrocyanic acid, carbon dioxide, nitrogen dioxide, nitric oxide, nitrous oxide, and ozone.

58. The powder of claim 51 wherein the light is ultraviolet light or visible light.

59. A powder for generating chlorine dioxide comprising:

a core containing a photocatalyst capable of being activated by light, and

particles or a layer on a surface of the core, the particles or the layer containing chlorite anions, the powder, when exposed to light, being capable of generating and releasing chlorine dioxide after activation of the photocatalyst and photo-oxidation or reaction of the anions.

60. The powder of claim 59 wherein the layer is continuous.

61. The powder of claim 59 wherein the layer and the particles are on the surface of the core.

62. The powder of claim 59 wherein the photocatalyst is selected from the group consisting of a metal oxide, a metal sulfide, a metal chalcogenite, a metal phosphide, a metal arsenide, a non-metallic semiconductor, a polymeric semiconductor, a photoactive homopolyanion, and a photoactive heteropolyion.

63. The powder of claim 59 wherein the metal oxide is selected from the group consisting of titanium dioxide, zinc oxide, tungsten trioxide, ruthenium dioxide, iridium dioxide, tin dioxide, strontium titanate, barium titanate, tantalum oxide, calcium titanate, iron (III) oxide, molybdenum trioxide, niobium pentoxide, indium trioxide, cadmium oxide, hafnium oxide, zirconium oxide, manganese dioxide, copper oxide, vanadium pentoxide, chromium trioxide, yttrium trioxide, silver oxide, and $Ti_xZr_{1-x}O_2$ wherein x is between 0 and 1; the metal sulfide is cadmium sulfide, zinc sulfide, indium sulfide, copper sulfide, tungsten disulfide, bismuth trisulfide, or zinc cadmium disulfide; the metal chalcogenite is zinc selenide, cadmium selenide, indium selenide, tungsten selenide, or cadmium telluride; the metal phosphide is indium phosphide; the metal arsenide is gallium arsenide;

the non-metallic semiconductor is silicon, silicon carbide, diamond, germanium, germanium dioxide, or germanium telluride; the polymeric semiconductor is polyacetylene; the photoactive homopolyanion is $W_{10}O_{32}^{-4}$; and the photoactive heteropolyion is $XM_{12}O_{40}^{-n}$ or $X_2M_{18}O_{62}^{-7}$ wherein x is Bi, Si, Ge, P or As, M is Mo or W, and n is an integer from 1 to 12.

64. A method for providing controlled generation and release of at least one gas comprising:
(a) providing a solid or a solids-containing suspension containing a photocatalyst and anions capable of photo-oxidizing or reacting to generate at least one gas, and
(b) exposing the solid or the solids-containing suspension to light to activate the photocatalyst and photo-oxidize or react the anions to generate and release the gas.

65. The method of claim 64 further including after step (b) the step (c) of preventing light from contacting the solid or the solids-containing suspension to stop or minimize generation and release of the gas from the solid or the solids-containing suspension.

66. The method of claim 65 further including after step (c) the step (d) of exposing the solid or the solids-containing suspension to light to resume or increase generation and release of the gas from the solid or the solids-containing suspension.

67. The method of claim 64 wherein the solid is a powder, a film, a coating, a tablet, or a fiber.

68. A method of retarding, killing, preventing or controlling microbiological contamination on a surface of a material,

within the material or in the atmosphere surrounding the material, comprising placing a material adjacent to a composition that does not release a biocidal gas in the absence of light, and exposing the composition to light to generate and release at least one biocidal gas from the composition into the atmosphere surrounding the material.

69. A method of retarding, preventing, inhibiting or controlling biochemical decomposition on a surface of a material or within the material comprising placing the material adjacent to a composition that does not release a biochemical decomposition-inhibiting gas in the absence of light, and exposing the composition to light to generate and release at least one biochemical decomposition-inhibiting gas from the composition into the atmosphere surrounding the material.

70. A method of controlling respiration of a material comprising placing the material adjacent to a composition that does not release a respiration-controlling gas in the absence of light, and exposing the composition to light to generate and release at least one respiration-controlling gas from the composition into the atmosphere surrounding the material.

71. A method of deodorizing a surface of a material or the atmosphere surrounding the material or enhancing freshness of the material, comprising placing a material adjacent to a composition that does not release a deodorizing gas in the absence of light, and exposing the composition to light to generate and release at least one deodorizing gas from the composition into the atmosphere surrounding the material.

72. A method of retarding, preventing, inhibiting, or controlling chemotactic attraction of an organism to a material, comprising placing a material adjacent to a composition that does not release an odor-masking gas or an odor-neutralizing gas in the absence of light, and exposing the composition to light to generate and release at least one odor-masking gas or odor-neutralizing gas from the composition into the atmosphere surrounding the material.

73. A method of retarding, preventing or controlling biological contamination of an atmosphere by exposing the composition to light to generate and release at least one decontaminating gas from the composition into the atmosphere surrounding the composition.

74. A method of retarding, killing, preventing, or controlling microbiological contamination, or retarding, preventing, inhibiting, or controlling biochemical decomposition on a surface of a material, within the material or in the atmosphere surrounding the material, deodorizing a surface of a material or the atmosphere surrounding the material, enhancing freshness of the material, or retarding, preventing, inhibiting, or controlling chemotactic attraction of an organism to a material, comprising placing a material adjacent to a composition that does not release chlorine dioxide gas in the absence of light, and exposing the composition to light to generate and release chlorine dioxide gas from the composition into the atmosphere surrounding the material.

75. A process for preparing a powder providing controlled sustained release of at least one gas, the process comprising:

admixing a photocatalyst and particles containing anions that are capable of photo-oxidizing or reacting to generate at least one gas with a solvent to form a suspension; and

forming a powder from the suspension, the powder, when exposed to light, being capable of generating and releasing the gas after activation of the photocatalyst and photo-oxidation or reaction of the anions.

76. The process of claim 75 wherein the particle is a salt selected from the group consisting of an alkali metal chlorite, an alkaline-earth metal chlorite, a chlorite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal bisulfite, an alkaline-earth metal bisulfite, a bisulfite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal sulfite, an alkaline-earth metal sulfite, a sulfite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal sulfide, an alkaline-earth metal sulfide, a sulfide salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal hydrosulfide, an alkaline-earth metal hydrosulfide, a hydrosulfide salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal nitrite, an alkaline-earth metal nitrite, a nitrite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal hypochlorite, an alkaline-earth metal hypochlorite, a hypochlorite salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine, an alkali metal

cyanide, an alkaline-earth metal cyanide, and a cyanide salt of a transition metal ion, a protonated primary, secondary or tertiary amine, or a quaternary amine.

77. A composite for electromagnetic energy-controlled generation and release of at least one gas comprising:

a gas-generating layer comprising an energy-activated catalyst capable of being activated by electromagnetic energy, and anions capable of being oxidized or reacted to generate at least one gas; and

a barrier layer adjacent to a surface of the gas-generating layer, the barrier layer being capable of transmitting electromagnetic energy to the gas-generating layer and being impermeable or semipermeable to the gas;

the gas-generating layer, when exposed to electromagnetic energy, being capable of generating and releasing the gas after activation of the catalyst and oxidation or reaction of the anions.

78. A composition for electromagnetic energy-controlled and moisture-controlled generation and release of at least one gas comprising:

an energy-activated catalyst capable of being activated by electromagnetic energy,

anions capable of reacting with a protic species generated during activation of the catalyst or oxidizing to generate at least one gas,

an acid releasing agent, and

anions capable of reacting with hydronium ions to generate at least one gas,

the composition, when exposed to electromagnetic energy and moisture, being capable of generating and releasing the gas after activation of the catalyst, hydrolysis of the acid releasing agent, and oxidation or reaction of the anions.